



PREPARATION AND CHARACTERIZATION OF POLYESTER RESIN-LAYERED SILICATE CONTAINING REACTIVE GROUPS

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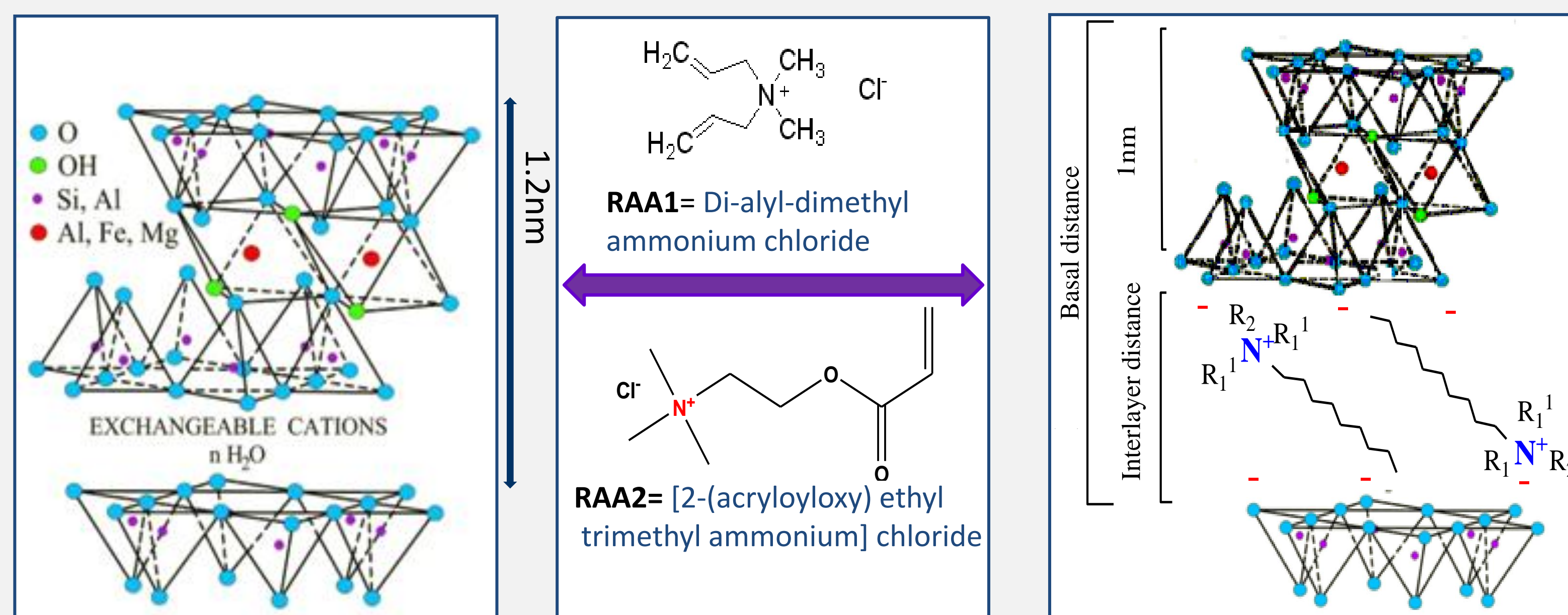
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INTRODUCTION

Polymer nanocomposites, specifically nanoclay-reinforced polymers, have attracted great interest as matrix materials for high temperature composite applications. Nanocomposites require relatively low dispersant loads to achieve significant property enhancements. These enhancements are mainly a consequence of the interfacial effects that result from dispersing the silicate nanolayers in the polymer matrix and the high in-plane strength, stiffness and aspect ratio of the lamellar nanoparticles. The montmorillonite (MMT) clay, modified with organic onium ions with long alkyl chains as Cloisites, has been widely used to obtain nanocomposites. The presence of reactive groups in organic onium ions can form chemical bonds with the polymer matrix which favours a very high exfoliation degree of the clay platelets in the nanocomposite (1,2).

MATERIALS AND METHODS



Preparation of reactive nanoclays

The ion exchange reaction was carried out by stirring the mixture of MMT and RAA's modifiers solutions for 2 h at 60°C and 15 h at room temperature to obtain the reactive nanoclay, RN. RN powder was obtained by freeze-drying the product.

Preparation of UP/RN nanocomposite

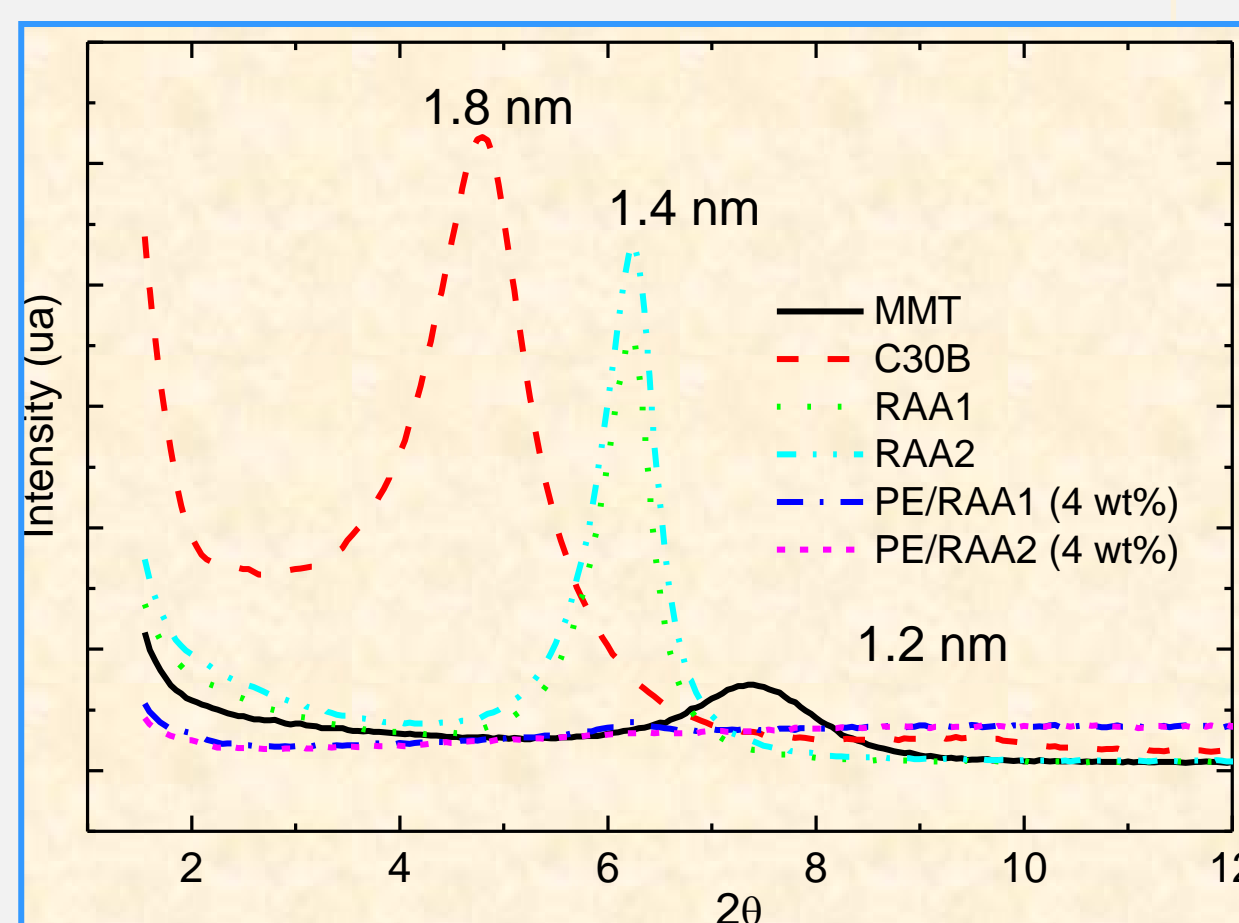
A mixture of UP resin + RAA1 or RAA2 (4% weight fraction) was stirred at 300 rpm at 50°C during 7 h. In both cases, well-dispersed mixtures and stable suspensions of the RAA's in UP were obtained. Crosslinking reaction was initiated adding 1.5 wt% of benzoyl peroxide to UP/RAA mixtures. Next the reactive mixtures were cured at 80 °C for 1 h and postcured for 3 h at 110 °C.

CHARACTERIZATION OF UP/RN NANOCOMPOSITES

WAXD

Reactive MMT's (MMT-RAA1 and MMT-RAA2) show a basal distance d_{001} of 1.4 nm which is between the corresponding ones to MMT-Na⁺ and commercial organic modified MMT (C30B).

UP/RN nanocomposites show no peaks in WAXD patterns in the $1.5^\circ < 2\theta < 10^\circ$ that could indicate exfoliated structures in the UP/RN nanocomposites.



CONCLUSIONS

The presence of double bonds in organic modified onium ions favours very high exfoliation degree of the clay platelets in the UP + MMT-RAA nanocomposite, as it has been revealed by WAXD, in contrast with the observed situation for similar nanocomposites reinforced with other Cloisites.

The exfoliated nanocomposites show an improvement in the mechanical behaviour with respect to the neat polyester thermoset. Increments of 28 % and 70% have been observed in the storage modulus of UP nanocomposites in glassy and rubber state, respectively. Also, Young modulus increases ~ 22%. The strength reaches practically the value of neat UP.

References: (1) Wang WS, Chen HS, Wu YW, Tsai TY, Chen-Yang YW. Polymer 2008;49:4826. (2) Chen-Yang YW, Lee YK, Chen YT, Wu JC. Polymer 2007;48:2969.

OBJECTIVES

- To modify MMT nanoclays using cationic exchange and to characterize the MMT modified clays.
- To analyze the effect of the type of reactive alkyl ammonium ion clay modifier (RAA).
- To compare the obtained results with the corresponding ones for the system Polyester thermoset/Cloisite C30B.

RESULTS AND DISCUSSION

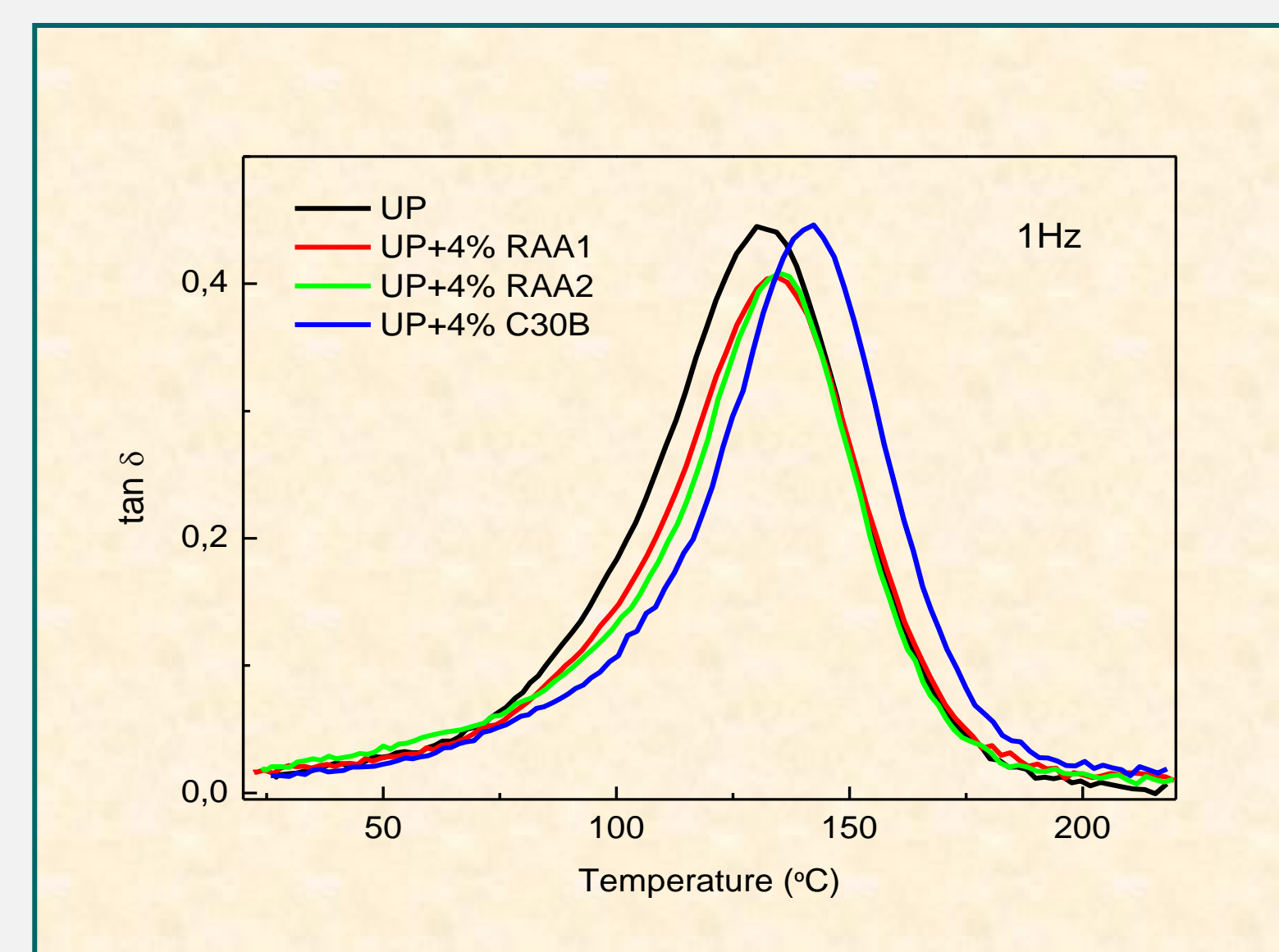
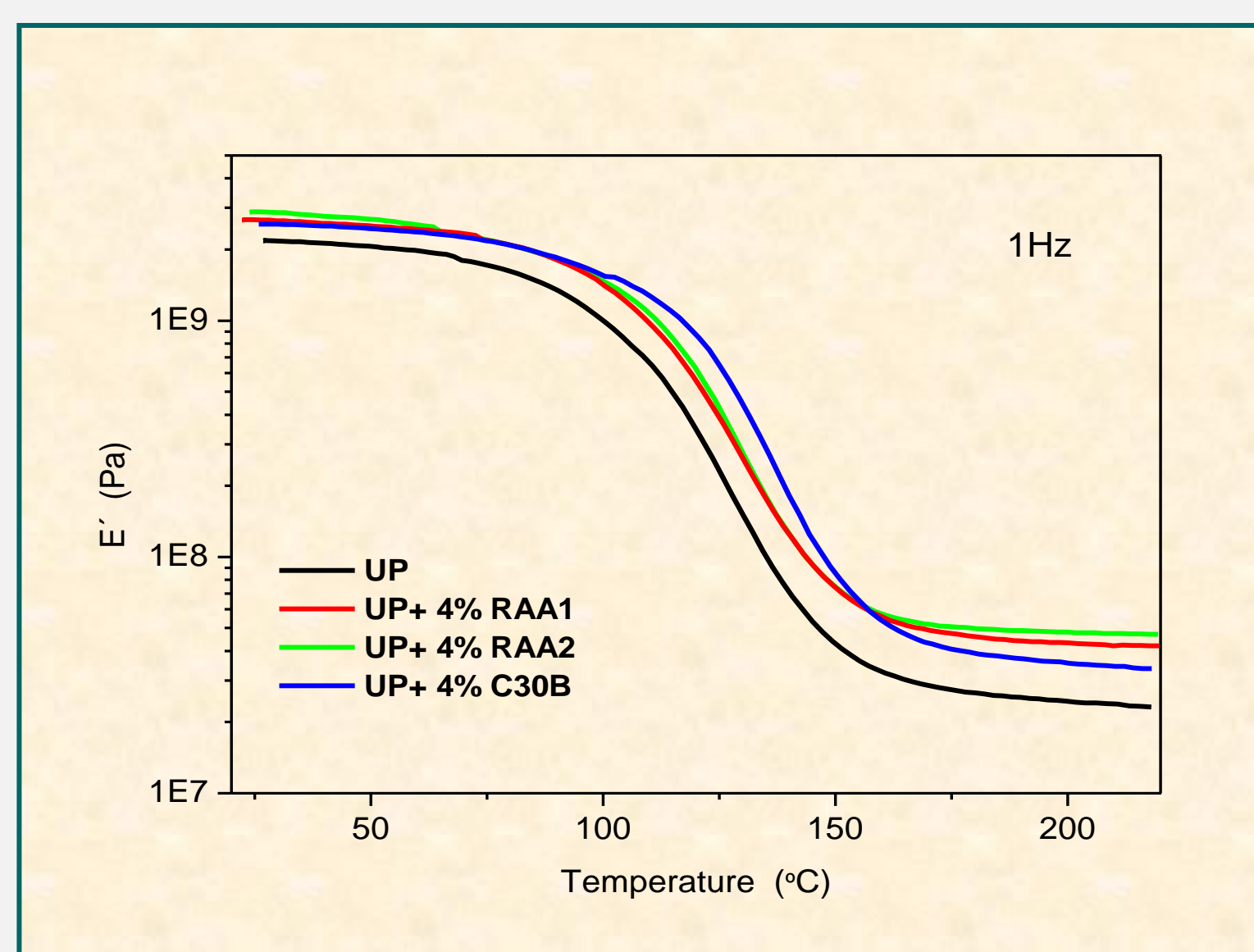
DSC

Sample	E _a (kJ/molUP)	ΔH (J/g UP)	T _g (°C)
UP	78±1	-352±10	108
UP + 4% RAA1	76±1	-362±13	114
UP + 4% RAA2	71±3	-356±11	115
UP + 4% C30B	75±3	-357±8	118

The glass transition temperatures, T_g, and ΔH of both RN nanocomposites are similar to that obtained for UP+C30B and a little higher than neat UP corresponding values.

Modified Cloisite RAA2 causes the highest catalyzed effect in the UP cured reaction as reveals its lower E_a value.

DMTA

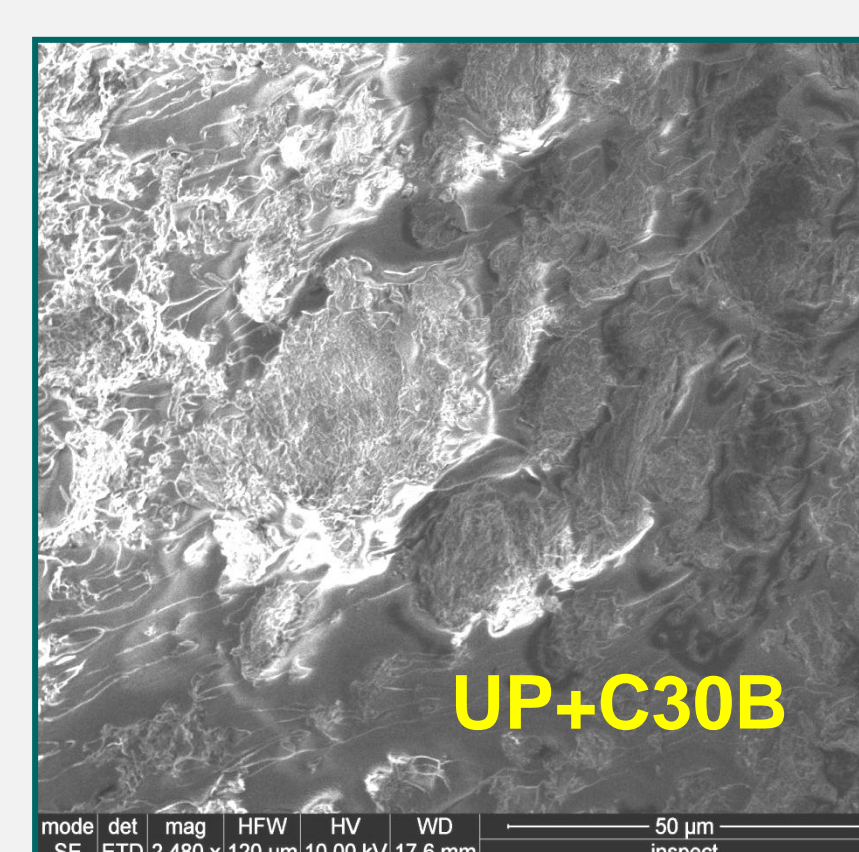


TENSILE TESTS

Sample	σ (MPa)	ε (% at fracture)	E (GPa)
UP + 4% C30B	40±5	1.1±0.1	4.5±0.1
UP + 4% RAA2	40±2	0,97±0.05	4,4±0.1
UP	43±3	1.31±0.04	3.7±0.1

The selected UP nanocomposites show an increase of ~ 28% in the value of the storage modulus, E' in the glassy region, respect to the E' value of neat UP. This increment reaches up to 70% in the rubber region. Young modulus increases ~ 22%. The strength reaches practically the value of neat UP.

The behaviour of both reactive modifiers and C30B would indicate that the size of the ion modifier do not have a significant influence in the thermo-mechanical properties of the UP+RN and UP+C30B nanocomposites.



Clay platelets in UP+C30B poorly dispersed

SEM

Clay platelets in UP+RAA2 well dispersed



Clay platelets in both cases are not strong enough to prevent the crack from propagating, leading to a UP nanocomposite more brittle than neat UP.